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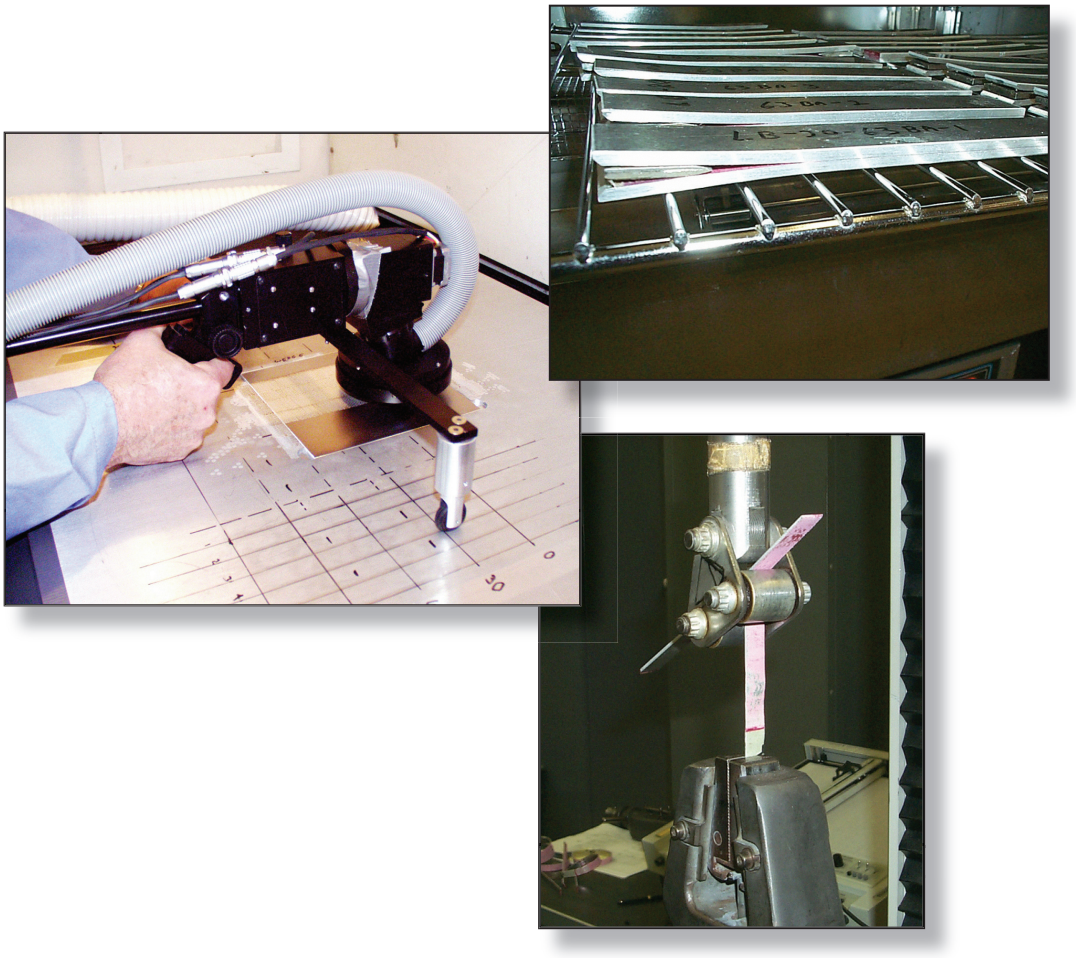
Science and Technology for Tomorrow's Air and Space Force

Success Story

LASER SURFACE PRETREATMENT METHOD FOR METAL ADHESIVE BONDING



The Materials and Manufacturing Directorate's Systems Support Division developed testing to demonstrate the use of a handheld laser that could eliminate laborious, time-consuming surface pretreatment activities associated with conventional surface preparations for aircraft metal bonding including composite patch repairs. Laser surface pretreatment minimizes worker exposure to hazardous materials because the process generates no waste other than that of the aircraft coating, which is ablated as flakes are vacuumed into a container for disposal.

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Accomplishment

Directorate engineers demonstrated that a low-power, handheld laser system can be used to pretreat aircraft surfaces before sol-gel adhesive bonding surface preparation. Extensive testing conducted with a prototype laser system proved the extreme promise of this technology as a method for removing organic coatings and contaminants from aluminum surfaces in an environmentally friendly manner. The laser provided the surface morphology and texture necessary to achieve acceptable bond strength and moisture durability when used with an environmentally friendly sol-gel treatment.

If the results of further testing prove positive, the system may offer significant advantages to maintainers conducting aircraft structural repairs. The Department of Defense and commercial industry have identified lasers as a potential environmentally friendly alternative to using chemical paint strippers and sand blasting.

Background

The Air Force Materiel Command Weapon Systems Pollution Prevention program funded the directorate's testing. The project engineers initially optimized and evaluated the system's ability to remove organic coatings and to texturize and clean the surface so that it would be suitable for bonding activities. They demonstrated that the technology was an environmentally friendly alternative to chemical stripping, hand sanding, grit blasting, and solvent cleaning of metallic surfaces. Wedge, lap-shear, and peel-resistance testing also showed that acceptable bond strength and moisture durability could be attained on surfaces contaminated by baked-on hydraulic fluid.

The Systems Support Division's Acquisition Systems Support Branch recently initiated a follow-on project at the directorate's Laser Hardened Materials Evaluation Laboratory to evaluate the handheld laser's removal capabilities in small areas and to provide the surface morphology required for acceptable aircraft-bonded repairs. Once again, engineers will use the water-based and hexavalent chrome-free, sol-gel technology as the bonding treatment. The final phase of this project will evaluate the laser's ability to prepare titanium and composite surfaces for adhesive bonding.

Materials and Manufacturing
Emerging Technology

Additional information

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